

WHAT IS CLAIMED IS:

1 1. A method for real time determination the of mineral scale deposition rate from
2 a formation fluid comprising:

3 A) placing an optical probe having a probe surface which can measure
4 changes in refractive index at the probe surface, into contact with a
5 formation fluid produced or being produced from an oil well;

6 B) measuring the changes in refractive index at the probe surface; and

7 C) determining the on-set and rate, if any, of mineral scale deposition from
8 the formation fluid as a function of the changes in refractive index at the
9 probe surface;

10 wherein:

11 i) the probe surface which can be monitored for changes in refractive index is
12 in contact with the formation fluid;

13 ii) the probe, including the probe surface which can be monitored for changes
14 in refractive index, is composed of a material which can withstand an
15 extended period of contact with the formation fluid at the temperatures and
16 pressures present in oil wells; and

17 iii) the determination of on-set of mineral scale deposition and the mineral
18 scale deposition rate from the formation fluid takes place in real time.

1 2. The method of Claim 1 wherein the optical probe having a probe surface
2 which can measure changes in refractive index at the probe surface is an ATR
3 probe.

1 3. The method of Claim 2 wherein the ATR probe includes a means of
2 measuring the refractive index change associated with a material in contact with the
3 probe which is a photometer.

1 4. The method of Claim 3 wherein the photometer measures light in a
2 wavelength range of from 400 to 1500 nanometers.

1 5. The method of Claim 4 wherein the photometer measures light in a
2 wavelength range of from 500 to 700 nanometers.

1 6. The method of Claim 5 wherein the photometer measures light in a
2 wavelength range of from 630 to 690 nanometers.

1 7. The method of Claim 4 wherein the photometer measures light in a
2 wavelength range of from 800 to 900 nanometers.

1 8. The method of Claim 7 wherein the photometer measures light in a
2 wavelength range of from 850 to 900 nanometers.

1 9. The method of Claim 8 wherein the photometer measures light in a
2 wavelength range of from 870 to 890 nanometers.

1 10. The method of Claim 1 additionally comprising using an automated probe
2 cleaning device to clean, calibrate, insert and extract the probe surface.

1 11. A method for controlling mineral scale deposition from a formation fluid
2 comprising:

- 3 A) placing an optical probe having a probe surface which can measure
4 changes in refractive index at the probe surface, into contact with a
5 formation fluid produced or being produced from an oil well;
6 B) measuring the changes in refractive index at the probe surface;
7 C) determining the on-set and rate, if any, of mineral scale deposition from
8 the formation fluid as a function of the changes in refractive index at the
9 probe surface;

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- 10 D) comparing the rate, if any, of mineral scale deposition, to a predetermined
 11 range of acceptable mineral scale deposition; and
 12 E) effecting a change in the rate of addition, if any, to the formation fluid of an
 13 additive effective for preventing mineral scale deposition from a formation
 14 fluid ;

15 wherein:

- 16 i) the probe surface which can be monitored for changes in refractive index is
 17 in contact with the formation fluid;
 18 ii) the probe, including the probe surface which can be monitored for changes
 19 in refractive index, is composed of a material which can withstand an
 20 extended period of contact with the formation fluid at the temperatures and
 21 pressures present in oil wells;
 22 iii) the determination of the mineral scale deposition rate from the formation
 23 fluid takes place in real time; and
 24 iv) the rate of addition, if any, to the formation fluid of the additive effective for
 25 preventing mineral scale deposition from a formation fluid is:
 26 (1) increased when on-set of mineral scale deposition is detected or
 27 the mineral scale deposition rate is greater than the range of
 28 acceptable mineral scale deposition;
 29 (2) decreased when no mineral scale deposition is detected or the
 30 mineral scale deposition rate is less than the range of acceptable
 31 mineral scale deposition; and
 32 (3) unchanged when no mineral scale deposition is detected or the
 33 mineral scale rate deposition is within the range of acceptable
 34 mineral scale deposition.

1 12. The method of Claim 11 wherein the optical probe having a probe surface
 2 which can measure changes in refractive index at the probe surface is an ATR
 3 probe.

1 13. The method of Claim 12 wherein the ATR probe includes a means of
2 measuring the refractance of a material in contact with the probe which is a
3 photometer.

1 14. The method of Claim 13 wherein the photometer measures light in a
2 wavelength range of from 400 to 1500 nanometers.

1 15. The method of Claim 14 wherein the photometer measures light in a
2 wavelength range of from 500 to 700 nanometers.

1 16. The method of Claim 15 wherein the photometer measures light in a
2 wavelength range of from 630 to 690 nanometers.

1 17. The method of Claim 14 wherein the photometer measures light in a
2 wavelength range of from 800 to 900 nanometers.

1 18. The method of Claim 17 wherein the photometer measures light in a
2 wavelength range of from 850 to 900 nanometers.

1 19. The method of Claim 18 wherein the photometer measures light in a
2 wavelength range of from 870 to 890 nanometers.

1 20. The method of Claim 11 additionally comprising using an automated probe
2 cleaning device to clean, calibrate, extract and insert the probe surface.

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1 21. A system for controlling mineral scale deposition from a formation fluid
2 comprising a fluid flow path for flowing formation fluid recovered from a subsurface
3 formation; an optical probe having a probe surface which can measure changes in
4 refractive index at the probe surface associated with the formation fluid in the fluid
5 flow path providing data corresponding to the rate of deposition of mineral scale from

6 the formation fluid in the fluid flow path; and a processor for determining from the
7 data the rate of deposition of mineral scale from the formation fluid.

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